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CLIMATE CHANGE INFORMATION NEEDS OF APPLE GROWERS IN KUMAON HILLS OF UTTARAKHAND

JAGJEEVAN BARAKOTI[1] & MOHAMMAD ASLAM ANSARI[2*]

[1]*Doctoral Student, Department of Agriculture Communication College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India*

[2]*Professor, Department of Agriculture Communication, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India*

ABSTRACT

Awareness about climate change can empower the farmers to adapt and mitigate the losses. Timely access to and availability of information about various climate change parameters can prove to be critical for adaptation strategies and mitigation of losses due to climate variability and vulnerability. Apple, among many horticultural crops, holds great promise for the economy and livelihood of the people living in the hills of Uttarakhand, but apple crop is very sensitive to climate changes and variability. This study was undertaken to ascertain climate change information needs of apple growers in North Himalayan state of India, i.e., Kumaon region of Uttarakhand. The study was conducted in one purposively selected 'Nainital' district, which has the highest apple productivity in the state. Study sample comprised of 120 apple growers as respondents selected through probability proportionate to size (PPS) method, and the sample was spread across four villages. The study findings show that majority of the apple growers expressed the need for information related to climate change parameters, cropping practices and impact of adverse impact on apple crop. Further, age, landholding size, farming experience, extension contact, information-seeking behavior and scientific information were found to have significant positive correlation with climate change information needs of apple growers. The study will help the state government to formulate relevant policies and program strategies to enhance apple cultivation and improve apple productivity.

KEYWORDS: Climate Change; Climate Smart Agriculture; Climate Adaptation; Information Needs; Apple Growers; Climate change Impact on Apple Cultivation

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Original Article

1. INTRODUCTION

Climate change has emerged as a serious threat to global food security. The relationship between climate and agriculture are complex and multidimensional. Information about climate and awareness about indicators of climate change are therefore critical factors for effective adaptation and mitigation measures (Ansari *et al.*, 2018). According to IPCC (2001), climate change refers to any change in climate over time, which may be due to natural variability or as a result of human activity. 'Climate variability can force the farmers to adopt new practices, such as shifting sowing time, land preparations, length of growing time, time of harvesting and control and management of insects, pests and diseases (Raghuvanshi and Ansari, 2017). Researchers and policymakers are busy debating on the impact of climate change and accounting for the damage caused due to climate-induced changes regionally as

well as globally. A number of adaptation strategies and mitigation measures have been put forward by different stakeholders in agriculture sector, as it continues to be a critical component of development agenda of developing countries.

Horticulture crops are very sensitive and vulnerable to climate uncertainties and variability. Among the many horticulture crops, apple is the most widely grown crop in the hills of Uttarakhand. Apple being a temperate fruit crop, is grown extensively along the North Himalayan ridge, comprising states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand. Apple contributes more than half of the area under fruit cultivation as well as production in Uttarakhand (State Horticulture Mission, Government of Uttarakhand, 2016-2017), but due to substantial changes in climate, the area as well as production of apple is declining in Uttarakhand. The whole apple belt in Kumaon region of Uttarakhand is shifting due to climate uncertainties, such as warmer winters, lack of chilling temperature, precipitation and the extended heat stress during summer. These changes in climate along with many other environmental factors are perceived to be the main causes of decrease in production and productivity of apple crop.

Ansari *et al*. (2018) observed that Perceptions not only shape knowledge but knowledge also shapes perception. Farmers' perceptions about climate change, therefore, strongly affect how they deal with climate-induced risks and uncertainties, and undertake specific measures and coping strategies to mitigate the adverse impact of climate change on agriculture. Parmesan and Yohe (2003) reported that in response to the changes in regional climate, plant species are shifting their ranges in altitude and latitude; therefore, farmers need information about various parameters of climate, so as to account for the adverse impact of climate on apple cultivation.

According to Kemp (1976), "information has been described as the fifth need of mankind ranked after air, water, food and shelter". Ansari and Sunetha (2014) observed that "access to accurate, timely and reliable information plays a crucial role in farming". Information deficit, in itself, is a type of vulnerability, as it adversely affects farmers' decision-making regarding cultivation practices, harvesting and post-harvest management measures. This information deficit needs to be completed with accurate, adequate and relevant information from a trusted and credible source. To a significant degree, the effectiveness with which farmers adapt to climate change will depend on how efficiently information on various climate change parameters is made available to farmers. To effectively adapt to the vagaries of climate change, farmers need information about various parameters of climate change (Okoro, 2016). It is said to be the sole reason for declining area under apple cultivation and declining productivity of apple crop. We, therefore, need to find out the information needs of apple growers regarding climate change indicators.

Hence, the present study entitled "Climate Change Information Needs of Apple Growers in Kumaon Hills of Uttarakhand" was undertaken with the following objectives: (i) to study the Socio-personal, Economic, Psychological and Communication characteristics of apple growers;(ii) to find out Climate Change Information Needs of farmers and (iii) to determine the relationship between selected Socio-personal, Economic, Psychological and Communication characteristics of apple growers and climate change information needs.

2. METHODOLOGY

The study was undertaken in Kumaon region of Uttarakhand, a North Himalayan state of India. One district – out of 7 districts in Kumaon division - was selected purposively, as it has the highest area and production of apple; and one block – i.e., Ramgarh block, with four villages named Hartola, Nathuakhan, Umagarh and Satbungha were selected purposively, as

these villages had the maximum number of apple growers. Study sample comprised of 120 respondents selected through PPS method. The data was collected through pretested structured interview schedule and the data was analyzed using SPSS (v.17).

3. RESULTS AND DISCUSSIONS

3.1 Profile Characteristics of Apple Growers

The study findings in respect of profile characteristics of the respondents are given in table 1.

Table 1: Distribution of the Respondents based on Profile characteristics of the Respondents

Sl. No.	Variables	Frequency	Percentage (%)
1.	**Age**		
	Young (<35.51 years)	22	18.33
	Middle-aged (35.51 to 62.95 years)	79	65.83
	Old (> 62.95 years)	19	15.83
2.	**Level of Education**		
	Illiterate	7	5.83
	Primary School	21	17.5
	Middle School	18	15
	High School	25	20.83
	Secondary School	29	24.17
	Graduation and above	20	16.67
3.	**Landholding**		
	Small (< 0.2 acres)	11	9.17
	Medium (0.2 to 3.8 acres)	89	74.17
	Large (> 3.8 acres)	20	16.67
4.	**Farming Experience**		
	Less than 5 years	0	0
	5- 10 years	9	7.50
	10-15 years	34	28.33
	15-20 years	77	64.17
5.	**Annual income**		
	Low (< 0.14 lakh rupees)	3	2.50
	Medium (0.14 to 2.28 lakh rupees)	104	86.66
	High (> 2.28 lakh rupees)	13	10.83
6.	**Extension contact**		
	Low	30	25.00
	Medium	68	56.67
	High	22	18.33
7.	**Media Ownership**		
	Radio	5	4.16
	Television	114	95.00
	Newspaper	47	39.16
	Extension literature	0	0
	Farm Magazines	7	5.83
	Internet	48	40.00
	Mobile Phone	110	91.66
8.	**Mass media exposure**		
	Low	15	12.5
	Medium	80	66.67
	High	25	20.83
9.	**Scientific orientation**		
	Low	13	10.83

	Medium	104	86.67
	High	3	2.50
10.	**Risk orientation**		
	Low	15	12.50
	Medium	89	74.17
	High	16	13.33

A careful perusal of table-1 reveals that majority (65.83%) of the respondents were in the middle age category followed by 18.33% in 'young age' group and 15.83% in 'old age' group. As regards educational level, a large majority of the respondents (94.16%) had received formal education; out of 94.16%, 24.17% had education up to secondary level followed by high school level (20.83%), 7.5% educated up to primary level followed by 'graduation and above' (16.67%) and 'Middle school level (15%). Only 5.83% respondents were found to be illiterates. Further, majority of the respondents (74.17%) were medium farmers followed by 16.67% being large farmers and 9.17%being small farmers. As regard to farming experience, majority of the respondents (64.17%) had 15-20 years of experience followed by 28.33% of the respondents had 10-15 years of farming experience and 7.50% had 5-10 years of farming experience.

As regard to annual income of the respondents, majority of the (86.66%) respondents were in 'middle' income category followed by 10.83% earning high level of annual income, whereas only 2.50% were found to be in 'low' income category. In respect of extension contact, it was revealed that majority (56.67%) of the respondents have 'medium' level of extension contact and 25% of the respondents have 'low' level of extension contact and only 18.33% of the respondents in the study sample had 'high' level of extension contact. Further, as regard to media ownership, 95% of the respondents had television followed by 91.66% having mobile phone, 40% having access to internet, 39.16% getting newspaper, whereas only 5.83% had subscribed to a farm magazine, 4.16% of the respondents had owned radio and none of the respondents subscribed/accessed extension literature.

According to mass media exposure of respondents, majority of them (66.67%) reported medium level of mass media exposure followed by 20.83% with high and 12.5% with low level of mass media exposure. Further, majority of the respondents (86.67%) had 'medium' level of scientific orientation followed by 10.83% had 'low' level and only 2.5% of the respondents had 'high' level of scientific orientation. Additionally, majority of the respondents (74.17%) displayed medium level of risk orientation followed by 13.33% having high level of risk orientation and 12.5% with low level of risk orientation.

3.2 Access to Weather Forecasts

Information in the contemporary society is perceived as a critical factor of production in farming along with land, labor and capital. Horticulture crops, especially apple, are very sensitive to climate variability and uncertainties. Mountain ecosystem is very sensitive to slight changes in the weather parameters. Of late, the state and central governments have strengthened the system of weather forecasts in the country. Hence, farmers, who are registered with a service provider are getting access to daily/weekly/fortnightly weather forecasts through various sources including mobile SMS alerts. Figure-1 gives the study findings with respect to sources of weather forecasts utilized by apple growers.

It is evident from figure.1 data that Radio (83%) and Television (88%) are the two most used mass media regarding access to daily weather forecasts. Even internet-based sources are being used daily by 53% respondents; however, Kisan Call Centre, as a source of information about weather, is used only weekly. With respect to daily weather forecasts, mobile SMS alerts are the least utilized media. It could be due to the fact that there are apple growers in the study

area, who did not get registered with daily weather forecasts services providers or there is no agency providing the daily weather forecasts.

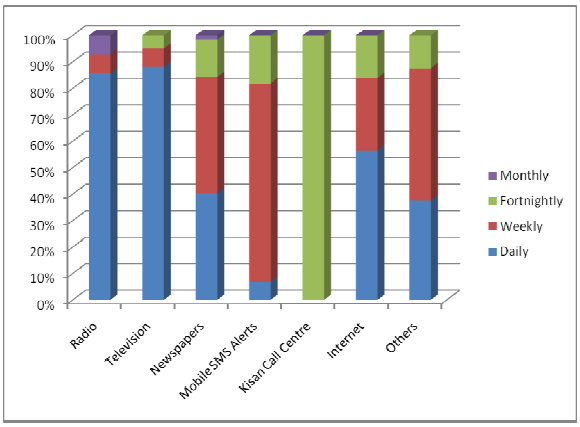

Figure1: Distribution of the Respondents according to Sources of Weather Forecast.

These findings are supported by **Okoro (2012)** who revealed that 95% of the respondents used newspaper for getting information regarding climate and weather, whereas 63.8% of the farmers used radio. However, these findings are in contrast to the findings of current study because researcher also reported that smaller portion of the respondents (46.2%) used television as the source to access weather forecast.

3.3 Climate change Information needs of Apple Growers

Information has emerged as a critical factor in farming, as it helps the farmers to make decisions about cultivation practices and application of agri-inputs. These are often referred to as Agriculture information needs. However, the specific information needs expressed by the target farmer, i.e., apple growers regarding climate change was the focus of the present study. As majority of Indian agriculture is primarily rainfed, information needs about climate change holds critical importance.

Climate change information needs studied in this research were categorized into three sub-categories, viz., knowledge of climate parameters, adaptation regarding cropping practices and perceived impact of climate change on apple productivity. Climate change information needs of apple growers were determined (using an index developed, specifically for the study) and quantified on the basis of these three sub-categories; and the results obtained are given below.

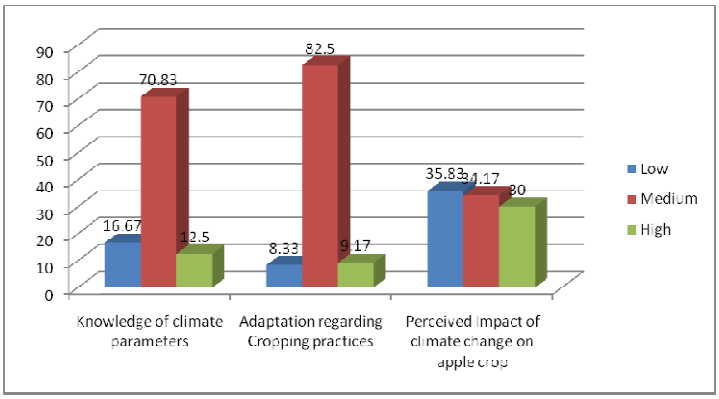

Figure 2: Distribution of the Respondents on the basis of Climate change Information Needs.

It is evident from the results presented in **table 1** that majority of the respondents (70.83%) expressed 'medium' level of information needs on climate parameters followed by 16.67% who had 'low' and 12.5% who had 'high' level of information needs related to different climate parameters. Further, a large majority (82.5%) of the respondents had medium level of information needs regarding cropping practices followed by 9.17% of expressing 'high' level and 8.33% of the respondents having 'low' level of information needs. Regarding perceived impact of climate change on apple crop, it was revealed that 35.83% of the respondents were having 'low' level of information need about the impact of climate change on apple productivity followed by 34.17% who exhibited 'medium' need level and 30% with 'high' level of information need about impact of climate change on apple productivity.

Farmers' knowledge about climate change parameters and adaptation regarding cropping practices may have been influenced by the National Initiative on Climate Resilient Agriculture (NICRA), a special project being implemented by Indian Council of Agricultural Research, Government of India, New Delhi. However, low perceived impact of climate change on apple crop indicates that farmers need persuasion at the grassroots' level about the efficacy of the suggested strategies being implemented under NICRA.

3.4 Impact of Climate change on Apple Productivity

Adverse climate affects apple quality, total production as well as productivity. Its impact can be seen on various stages of apple crop, such as flowering, fruiting, fruit setting, fruit size and overall appearance of the apple fruit. Climate change, therefore, negatively affects total apple productivity. An attempt was made by the researcher to find out the information needed by apple growers regarding the impact of climate change on apple productivity. The findings are presented in figure-3.

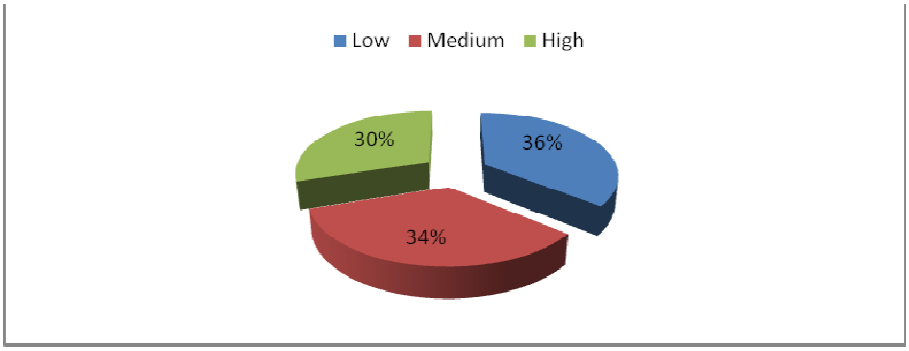

Figure 3: Impact of climate changeon Apple Productivity.

It is evident from the results presented above that 36% of the apple growers were found to be having 'low' level of information need about the impact of climate change on apple productivity followed by 34.17% who exhibited 'medium' need level and 30% with 'high' level of information need about the impact of climate change on apple productivity. These results clearly show that majority of the respondents require information about the adverse impact of climate change on apple productivity.

In a similar study conducted by **Umunakwe (2014)**, it was revealed that farmers desired to seek information on the effects, causes, vulnerable groups, appropriate socio-cultural practices, crops adaptable and sources of information on climate change. Additionally, farmers indicated that they needed information on the effects of climate change, causes of climate change, vulnerable groups to climate change, appropriate socio-cultural practices in climate change, crops adaptable to climate change, sources of information on climate change, agroforestry practices, flood/ erosion control practices, afforestation

practices, carbon trading and adaptation strategies. **Prokopy *et al.* (2014)** observed that 8% of the respondents told that climate change is occurring and this is because of human activities; 33% of the respondents believed that climate change is caused by human interventions and natural change in the environment, 25% of the respondents believed that climate change is caused mostly by natural changes in the environment and 35% of the respondents believed there is either insufficient knowledge to know with certainty that climate change is occurring or believed that climate change is not occurring.

3.5. Relationship between Profile Characteristics of Apple Growers and Climate Change Information Needs

Correlation Analysis

An attempt was made, as per the study objectives, to find out the relationship between selected profile characteristics of apple growers and their climate change information needs. The results obtained are presented in table 2 below.

Table 2: Correlation Analysis between Independent and Dependent Variables

Variables	Correlation Coefficient (r)	t cal at 5% Level of Significance
Age	0.186*	2.1
Education	-0.165 NS	-1.823
Land holdings	0.193*	2.143
Total area under apple cultivation	-0.009 NS	-0.097
Farming experience	0.463**	5.694
Annual income	-0.088 NS	-0.962
Extension contact	0.227*	2.540
Mass media ownership and exposure	-0.152 NS	-1.676
Scientific orientation	0.227*	2.540
Access to weather forecasts	0.182*	2.017
Risk orientation	0.090NS	0.982

*NS = Non-significant; *Significant at 5% level of significance and **Significant at 1% level of significance; t-value at 0.05 level of significance (df = 119) = 1.9803; t-value at 0.01 level of significance (df =119) = 2.6181*

Table 2 reveals that the independent variable, viz. Age, Landholding, Farming experience, Extension contact, and Scientific orientation had significant and positive relationship with climate change information needs of apple growers. It was also found that education, total area under apple crop, annual income and mass media ownership and exposure had non-significant and negative relationship with the climate change information needs of apple growers. Further, it was also found that risk orientation had positive but non-significant relationship with the climate change information needs of apple growers. **Umunakwe *et al.* (2014**) also reported that age, landholdings and social participation had significant and positive relationship with climate change and information needs. **Maddison (2007)** stated that educated and experienced farmers have more knowledge and information about climate change and agronomic practices, such that they can adapt in response. It shows a positive relationship between farming experience and climate change information need.

Regression Analysis: Impact of Independent Variable on Dependent Variable

Partial regression analysis was done to find out the impact of selected independent variables on the dependent variable included in the study. It was done to find out how independent variables (age, education, land holdings, total area under apple cultivation, farming experience, annual income, extension contact, mass media ownership and exposure, scientific orientation and risk orientation) are related with dependent variable (climate change information needs). The regression equation was developed between independent and dependent variables along with computing the coefficient of determination. Regression equation was believed will help to explain the impact of independent variables on dependent variable.

Table 3: Partial Regression Analysis

Variables	B value	t value	p value
Constant	0	5.578	0.000
Age	0.064	0.740	0.461
Education	-0.090	-1.008	0.316
Land holdings	0.115	1.228	0.222
Total area under apple cultivation	-0.076	-0.757	0.451
Farming experience	-0.319	**3.809****	0.000
Annual income	-0.076	-0.908	0.366
Social participation	-0.170	**-2.065***	0.041
Extension contact	0.170	**1.992***	0.049
Mass media ownership and exposure	-0.182	-2.038	0.44
Information seeking behavior	0.228	**2.778****	0.006
Scientific orientation	0.086	1.024	0.308
Risk orientation	0.005	0.062	0.950

*(*Significant at 5% level of significance and **Significant at 1% level of significance)*

It may be inferred from table-3 that the partial regression coefficients for nine independent variables (age, landholding, farming experiences, extension contact, information seeking behavior, scientific orientation, access to weather forecasts and risk orientation) had positive relationship with the dependent variable, which shows that the one unit change in the independent variable(s) will result in corresponding increase in the dependent variable. Similarly, four independent variables (education, total area under apple cultivation, annual income, mass media ownership and exposure) had negative relationship with the dependent variable (climate change information needs), which shows that one unit change in the independent variable(s) will result in one unit decrease in the dependent variable. However, relationship of five independent variables, viz., farming experience, social participation, extension contact, information seeking behaviour and access to weather forecast were found to be significant with climate change information needs. Thus, we may conclude that these five independent variables had more strong impact on the dependent variable.

Further analysis tried to develop a regression equation in order to find out the Coefficient of Determination (R^2), which is an indicator of the cumulative impact of all the selected independent variables on the dependent variable. Results are given in the following table-4:

Table 4: Multiple Regression Equation for Independent Variables with Dependent Variable (Climate Change Information Needs)

Dependent Variable	Regression Equation	R^2
Climate Change Information Needs	$5.578+0.186X_1-0.165X_2+0.193X_3-0.09X_4+0.463X_5-0.088X_6-0.019X_7+0.227X_8-152X_9-0.321X_{10}+0.227X_{11}+0.09X_{13}$	0.4020

It can thus be inferred from the results given in table-4 that Coefficient of determination (R^2) is 0.402, which means that only 40.2% of the variation in the dependent variable (Climate change information needs) could be attributed to all the independent variables included in the current study. However, 59.8% of the variation in the dependent variable under study could be attributed to other extraneous/intervening variables not included in the study.

Thus, we can conclude that future researchers probing the climate change information needs of apple growers should explore more and focus on the factors not included in the present study, but which may contribute in determining the climate change information needs of the apple growers. Extensive field interactions with apple growers coupled with discussions with subject experts will help to refine the research approach in determining the climate change information needs of apple growers.

4. CONCLUSIONS

Climate change impact is threatening global strategies of ensuring food security and eradicating hunger and poverty afflicting the developing and underdeveloped countries. Lack of awareness about climate change indicators and its adverse impact on agriculture is, therefore, of critical importance. This hinders the adaptation at farm level. Identification of climate change information needs, therefore, assumes greater importance, as they not only affect the productivity but also disrupt the rural livelihood systems, thereby, making them vulnerable socially as well as economically.

Horticulture crops are, by their very nature, very sensitive to climate change, especially in mountain ecosystems. Apple being a temperate crop is adversely affected, as farmers lack information about various parameters of climate change. In order to overcome the adverse impact of climate change on apple crop, there is an urgent need to make apple growers aware of various indicators of climate change. The present study has highlighted the need to identify climate change information needs of apple growers and then formulate relevant strategies and programs to improve.

Information deficit regarding availability of climate change information at farm level is, therefore, very crucial so that farmers' confidence could be won back, and they do not shift or replace the apple crop with other alternatives. The study findings have reiterated the importance of climate change information needs of apple growers and showed how the information deficit at the farmer level is affecting the apple cultivation in the state of Uttarakhand. Appropriate media strategies to disseminate climate change information to apple growers along with suitable cropping practices can be helpful in mitigating the production losses to farmers.

The results of study showed that majority of the respondents had medium level of information needs on climate parameters, it may be due to low education level, low information seeking behaviour and low social participation. Majority of the respondents had medium level of information needs regarding cropping practices and majority of the respondents express their information needs about alternative crops grown in lower hills, it may be due to low extension contact. One-third of the respondents had low level of information needs about the impact of climate change and also one-third of the respondents had high level of information needs about the impact of climate change. It may be due to the low information seeking behaviour of the respondents. Results of the research study suggested that climate change information needs of apple growers were influenced by different explanatory variables. Regarding relationship of selected Socio-personal, Economic, Psychological and Communication characteristics of the respondents with the climate change information needs, it was found that age, landholding, farming experience, extension contact and scientific orientation had significant positive relationship with climate change information needs of apple growers.

Therefore, it may be concluded that the extension system can make a significant contribution by identifying the climate change information needs of target clients, so that climate smart polices and programs related to horticulture crops can be formulated on the basis of climate change information needs. Extension professionals and strategists can also help to satiate climate change information needs of apple growers and build a positive enabling framework to adopt new scientific technologies to mitigate the impact of climate change on apple crop.

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AUTHORS PROFILE

Dr. MOHAMMAD ASLAM ANSARI is presently working as Professor in the Department of Agriculture Communication, College of Agriculture, G B Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). He holds a doctoral degree in Extension Education followed by Post-Doctorate in Communication from Centre for Mass Communication Research (CMCR), University of Leicester (UK). Dr. Ansari has more than 25 Years experience of teaching, research, extension, training and technical assistance in various sectors such as Corporate, Government, NGO and Academic sectors. He has published more than 75 research papers in reputed national and international journals besides 40 popular articles in farm magazines; published two books, six book chapters, and has attended (also chaired sessions in) many national and international conferences/ conferences/ workshops in India and abroad. The areas of his professional research interests include Climate change and Agriculture, ICT applications in agriculture and rural development, e-learning/ e-learning readiness, Agriculture extension systems, and Development Communication. Besides, he is Life Member of Five professional associations and Reviewer of four international journals and five national journals besides being Editor of a monthly farm magazine (Indian Farm Digest), and chairman of Editorial board of one national journal (Indian Journal of Science Communication). He is also the Founder-chairman of Indian Science Communication Society.

Mr. JAGJEEVAN BARAKOTI holds a Graduate (B Sc Agriculture) and Master's Degree (M. Sc. - Agricultural Extension and Communication) from G. B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar and currently pursuing doctoral degree in Agricultural Extension and Communication at GBPUAT. He has attended 6 national conferences and 2 national workshops; and written 5 articles and a book chapter. His research interests are focused on Climate Change and Agriculture, Information needs of farmers and Hill agriculture.